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ARGON.

THE plain facts concerning argon are these: For some time past Lord Rayleigh has been engaged on refined work involving the weighing of various gases. Last year he found that the nitrogen obtained from the air is a little heavier than that made from definite chemical compounds. This led him to further experiments and, at the same time, Professor W. Ramsay, of University College, London, also undertook experiments with the object of explaining, if possible, the discrepancy. The general method of work consisted in passing air, first through substances that have the power to remove those constituents that are present in small quantities, such as water vapor, carbonic-acid gas, etc., then through a heated tube containing copper. The oxygen of the air unites with the heated copper, and what has hitherto been regarded as nitrogen remains uncombined. This 'atmospheric nitrogen' was subsequently treated in three different ways for the purpose of removing the nitrogen from it.

(1) It was drawn through clay pipes in the hope that, if the gas is a mixture, one of the constituents would pass through the porous material more easily than the other, and at least a partial separation be thus effected. While something was accomplished in this way, the experiment was on the whole unsatisfactory.

(2) The 'atmospheric nitrogen' was mixed with oxygen in a vessel containing caustic alkali, and electric sparks were passed through the mixture. Under these circumstances the oxygen united with nitrogen and formed a compound which is soluble in alkali. After no further absorption of nitrogen could be effected by sparking, any unchanged oxygen present was removed, and there was then found a residue

of gas which was certainly not oxygen nor nitrogen. This proved to be the substance about which the world is now talking.

In this connection it is of great interest to note that Cavendish, in 1785, probably had this same substance before him free from nitrogen. He performed the experiment above described, and noticed the residue, and says in regard to it: "We may safely conclude that it is not more than $\frac{1}{120}$ of the whole." This is very nearly the truth as regards the relative amount of argon in the air.

(3) The most satisfactory method for obtaining the gas on the large scale consists in passing 'atmosphere nitrogen' over highly-heated magnesium, which has the power of uniting with nitrogen, while the newly-discovered gas has not this power. But, even by this method, the preparation is very slow, and, up to the present, the gas cannot easily be obtained in large quantity.

The new substance is heavier than nitrogen. The density of hydrogen being taken as unity, that of nitrogen is 14, of oxygen 16, and of argon 19.7.

Perhaps the most remarkable property of argon is its inertness. It has not been possible thus far to get it to combine with any other substance, so that anything more than a general comparison with known substances is out of the question. It owes its name to its inertness, argon being derived from two Greek words signifying 'no work.'

A determination of the ratio of the specific heat of argon at constant pressure to that at constant volume was determined by means of observations on the velocity of sound in the gas, and the ratio was found to be 1.66. This is of much importance as showing that the particles of which the gas is made up act as individuals. If this conclusion is correct, it follows further that argon must be either a single element or a mixture of elements, and that, if it is a single element, its atomic weight must be nearly 40, as its density is 19.7 and its atom is identical with its molecule.

Professor Crookes has studied the spectra of argon and, in an article giving his results in detail, he says: "I have found no other spectrum-giving gas or vapour yield spectra at all like those of argon." * * * "As far, therefore, as spectrum work can decide, the verdict must, I think, be that Lord Rayleigh and Professor Ramsay have added one, if not two members to the family of elementary bodies."

Finally, Professor Olszewski, of Cracow, the well-known authority on the liquefaction of gases has succeeded in both liquifying and solidifying argon. It was found to boil at 186.9° C., and to solidify at 189.6° C., forming a mass resembling ice.

To quote from Professor Ramsay's article read before the Royal Society: "There is evidence both for and against the hypothesis that argon is a mixture: *For*, owing to Mr. Crookes' observations of the dual character of its spectrum; *against*, because of Professor Olszewski's statement that it has a definite melting point, a definite boiling point, and a definite critical temperature and pressure; and because, on compressing the gas in presence of its liquid, pressure remains sensibly constant until all gas has condensed to liquid."

The above is a brief account of all that is known about argon, and it would evidently be premature to indulge in speculation regarding its position in the system. It may as well be said at once that, if it is an element or a mixture of elements, it will apparently be difficult to find a place for it on Mendeléeff's table. It will be well to await developments before worrying on this account. If the time should ever come when Mendeléeff's table has to be given up, something better will take its place.

The suggestion has been made repeatedly that argon is perhaps an allotropic form of nitrogen. The strongest argument against

this view is the established fact that the gas conducts itself as if made up of individual particles, while any allotropic form of nitrogen, which is heavier than this, must, according to all that we know of such matters, consist of more complex molecules than nitrogen itself.

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*THE FUNDAMENTAL DIFFERENCE BETWEEN PLANTS AND ANIMALS**

To the advanced student, as to the investigator, the question of a definite and accurate distinction by which all true plants can be distinguished from all true animals, is a question of minor interest. To the beginning student the question, on the contrary, is a pressing one for which the answer is urgently claimed. Thus I am led to believe that the definition given below, though it cannot add anything essential to the conceptions of investigators, will nevertheless prove valuable to teachers of biology.

The usual method of drawing a contrast between the animal and vegetable kingdoms, for the purpose of establishing some sort of definition of the two in students' minds, is to leave out of consideration the lower forms, and to take into consideration only the higher forms, on the one side plants with chlorophyll, on the other the multicellular animals or so-called Metazoa. It is then easy to establish a difference in the physiological nutritive processes, emphasizing the synthetic processes, particularly the power of bringing free nitrogen into combinations on the part of plants and the absence of the synthetic process among animals. It is much to be regretted that this method of defining animals and plants has been and still is very widely used, for it leads to inevitable perplexity, because the next thing almost which the student must learn is that the distinction does not hold true. On the one hand, he learns that among plants there are many forms without chlorophyll and that these cannot bring nitrogen into combination and must secure proteid food. On the other hand, he learns that among animals numerous synthetic processes occur, and if he takes up the study of medical physiology he learns many instances of synthetic chemical work on the part of the mammalian body. Dr. F. Pfaff has kindly indicated to me two striking instances of synthesis in the mammalian body, first, the formation of glycuronic acid after the administration of camphor or turpentine, and second, the formation of hippuric acid after the administration of benzoine.

Another distinction often drawn between animals and plants is that of the presence or absence respectively of internal digestive organs. But this again soon leaves the student in the lurch, for the first amœbea he examines knocks that distinction out of the ring.

We may, however, I think, rightly define the two primary divisions of the living world thus:

Animals are organisms which take part of their food in the form of concrete particles, which are lodged in the cell protoplasm by the activity of the protoplasm itself.

Plants are organisms which obtain all their food in either the liquid or gaseous form by osmosis (diffusion).

There are certain facts which appear to invalidate these definitions. The most important of such facts, so far as known to me, is afforded by the Myxomycetes, which, as well known, while in the plasmodium stage of their life-cycle, take solid particles of food very much after Amœba-fashion. Through the kindness of Professors W. G. Farlow and G. L. Goodale, I have learned that there are no other plants which at the present time are known to take solid food

* Read before the American Society of Morphologists at Baltimore, December, 1894.